

Status and Potential of U.S. CHP

1st International Symposium - Combined Heat and Power

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Overview

Brief History

Current Status

CHP Potential

CHP Forecasts

Conclusions

In the Beginning

CHP was the core of the early U.S. electric generating industry.

As separate electric utilities developed, CHP focused on industrial facilities with certain characteristics:

Characteristics

- High steam demand
- Constant loads
- “Free” byproduct fuels

Industries

- Paper
- Chemicals
- Refining
- Iron & steel

Traditional CHP

Base-loaded thermal energy

Electricity is the “by-product”

High percentage of boiler/steam turbine systems:

- Dependence on low-cost/low quality fuels
- Low power-to-heat ratio - high efficiency

CHP in the 1960s

Regulated utilities controlled the electricity market and often:

- Refused to purchase CHP power
- Imposed high back-up and stand-by rates

Regulatory barriers - PUHCA, FPA - also discouraged broader CHP development.

PURPA

Passed in 1978 to encourage energy efficiency.

- Required electricity buy-back at avoided cost
- Reasonable stand-by and back-up charges
- PUHCA exemption

Had the expected effect on CHP.

Did not foresee that it would be the stimulus for broader electric industry restructuring.

PURPA Impacts

For the first time, allowed non-utility participation in the electricity market.

Triggered the development of third-party CHP developers who had equal or greater interest in electric markets as thermal markets - non-traditional CHP.

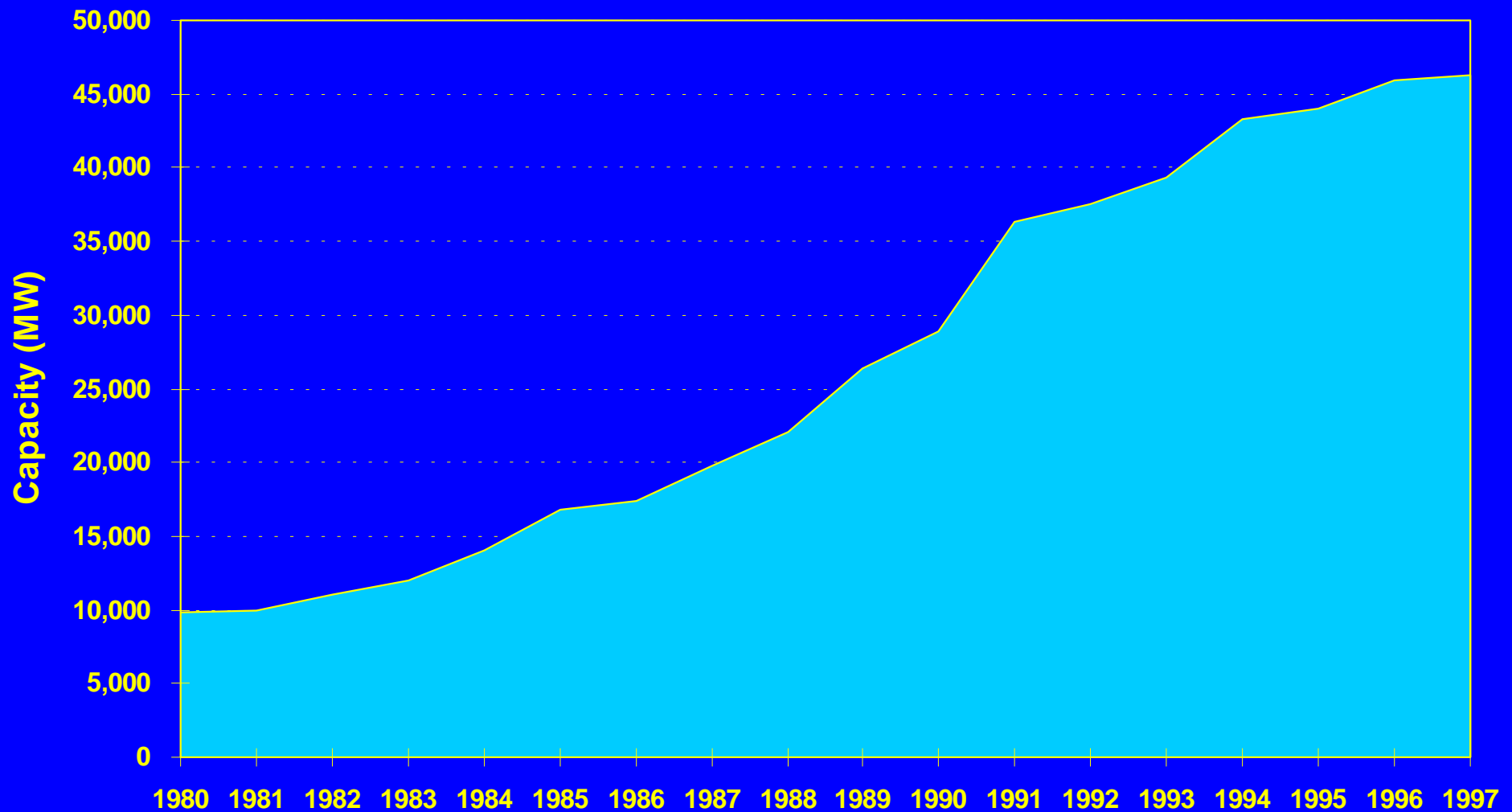
Started the progression towards merchant generation and open access.

PURPA Impacts (2)

The coincidental availability of bigger, better, lower cost combustion turbines and combined-cycle equipment with higher power-to-heat ratios caused a move towards CT technology and gas use.

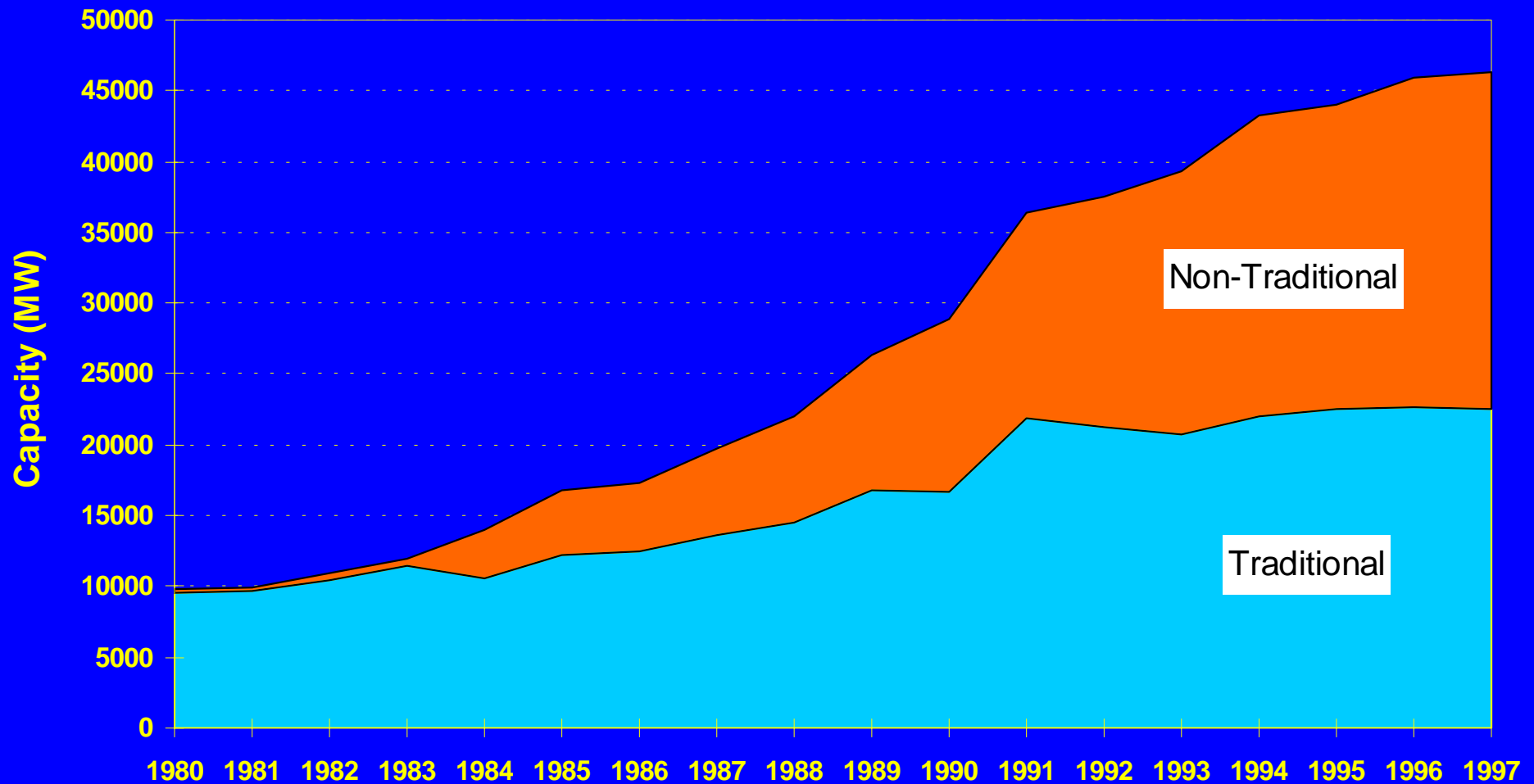
Resulted in some very large merchant plants leveraged towards high electricity production.

Growth of U.S. Industrial CHP



Source: Edison Electric Institute and Energy and Environmental Analysis, Inc.

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U.S. CHP Today

There is about 54,240 MW of CHP capacity generating 3,536 TWh per year.

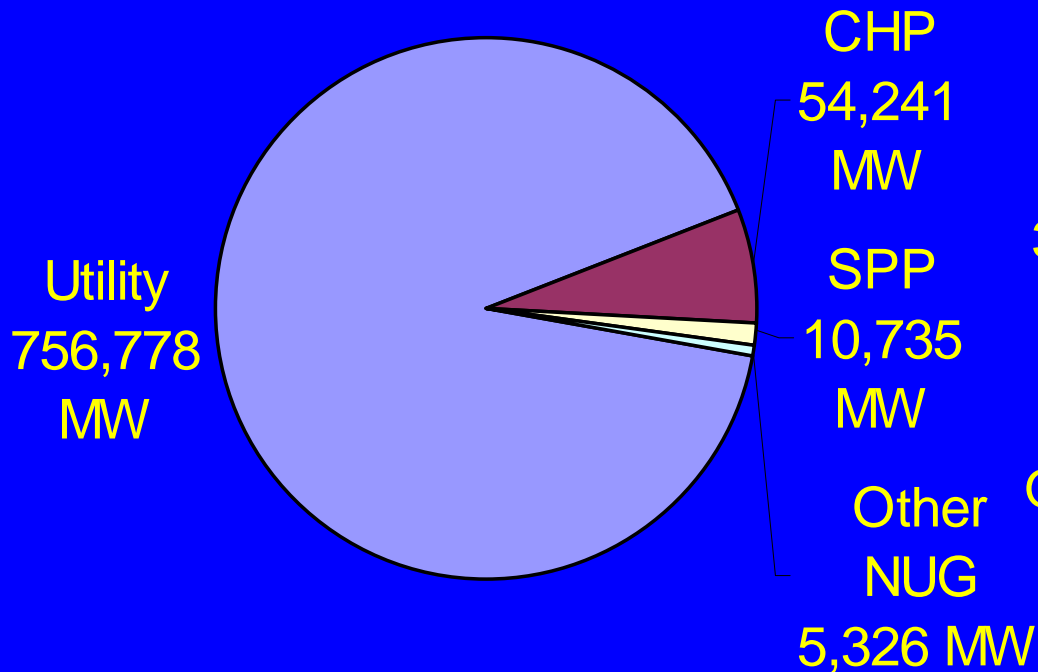
This is 7 percent of total U.S. generating capacity and 10 percent of generation.

Almost 90 percent of CHP generation and capacity are still in the industrial sector.

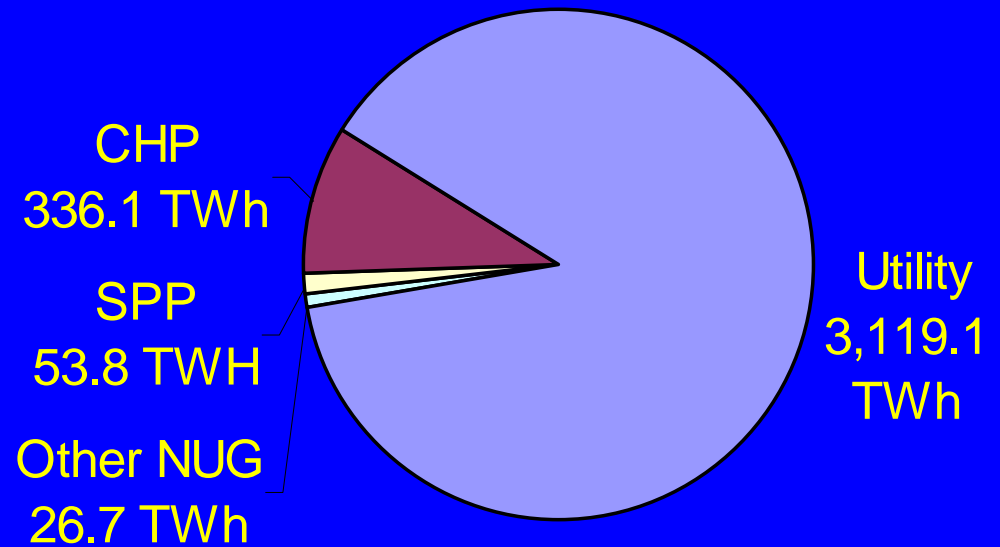
Four industries still make up 65 percent of the CHP capacity and generation.

U.S. CHP Status 1997

Capacity (MW)

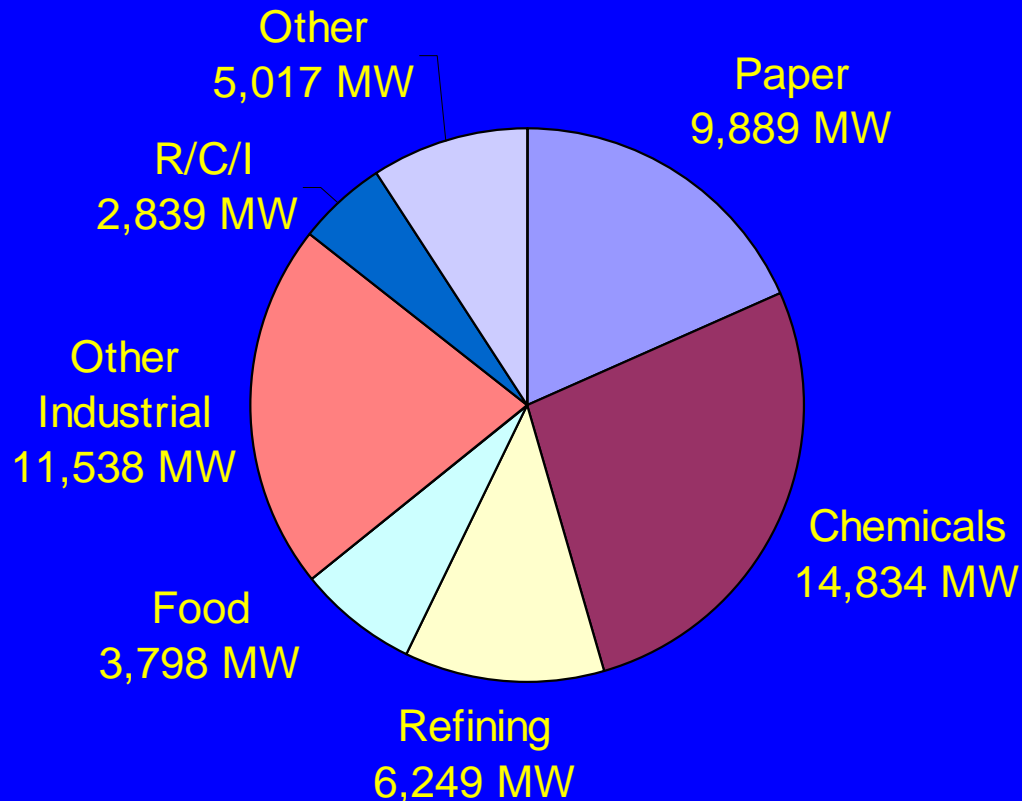


Generation (TWh)



Data Source: Edison Electric Institute

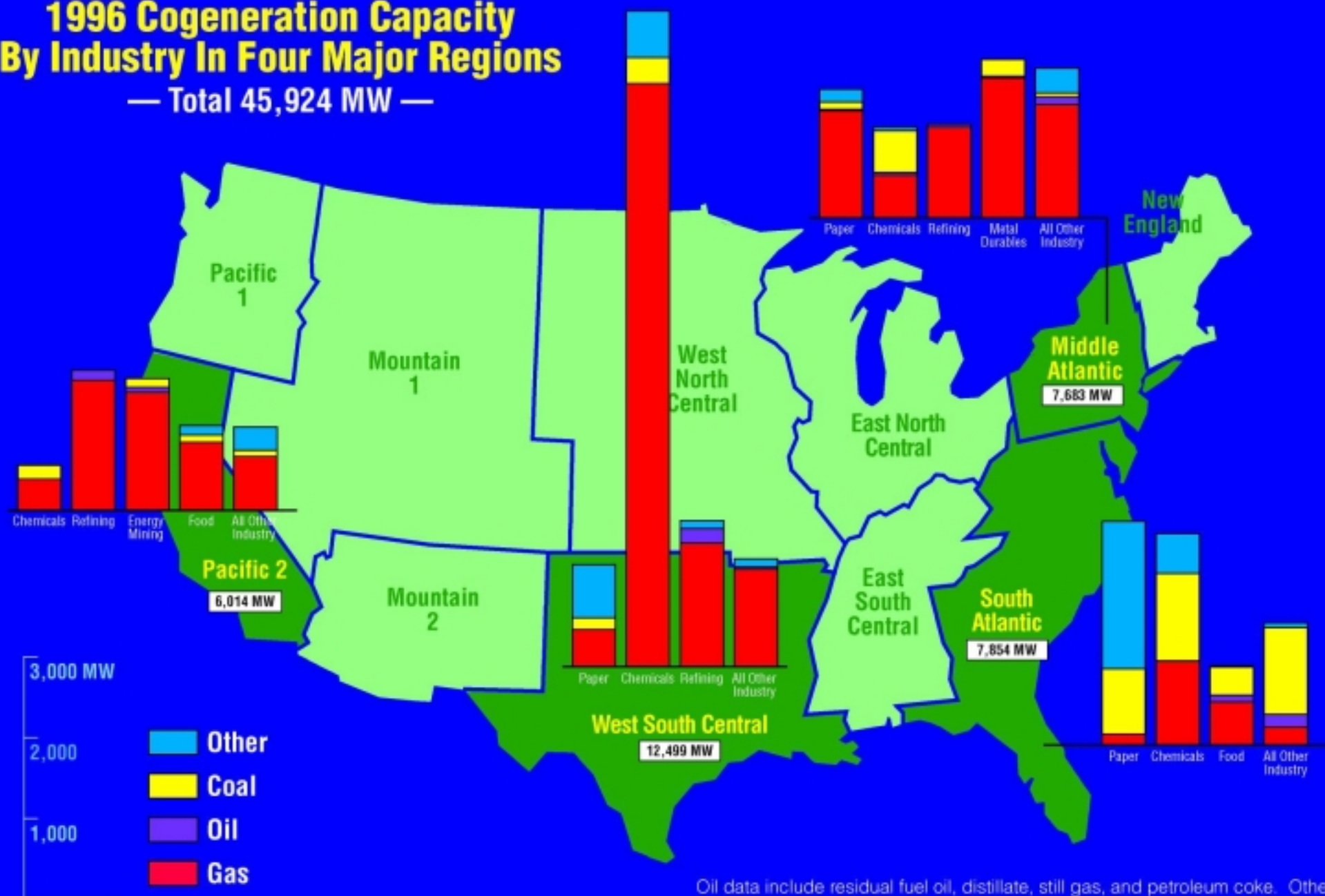
U.S. CHP Capacity by Sector



Data Source: Edison Electric Institute

1996 Cogeneration Capacity By Industry In Four Major Regions

— Total 45,924 MW —



Oil data include residual fuel oil, distillate, still gas, and petroleum coke. Other data include biomass, waste heat, coke oven gas, blast furnace gas, and other gas.

Source: Edison Electric Institute and Energy & Environmental Analysis, Inc.

Emission/Energy Benefits of CHP

A rough estimate of the energy and environmental benefits of CHP in place today compared to conventional systems is a savings/reduction of:

2,154 TBtu/year (33%)

1.3 MMtons SO₂/year (61 %)

738 ktons NO_x/year (63 %)

147 MMtons CO₂/year (37 %)

CHP Potential

2010 forecast of CHP potential has been forecast to be 160 GW.

- 100 GW industrial
- 60 GW district heating

Could vary based on power-to-heat ratio, among other variables.

GRI Forecast

GRI Baseline Projection shows a total of 9.4 GW growth from 2000 to 2010

- 5.1 GW Industrial
- 4.3 GW Residential/Commercial/Institutional

EIA Forecast shows only 3 GW growth by 2010 - only includes industrial, no third party or RCI.

Forecast vs Potential

In the 1980's and early 1990's - CHP was the “ticket” to participation in the electric market.

That is no longer the case -large merchant plants can now go straight IPP.

CHP is no longer a “requirement” but a cost commitment.

Forecast vs Potential

Efficiency-optimized CHP can be very competitive in a fully restructured market.

In the transition to a fully restructured market - CHP is once again disadvantaged, especially small applications.

- Limited access to electricity markets
- Expectation of low retail prices
- Low buyback/high back-up rates

Conclusions

The bulk of U.S. CHP today is still in the “traditional” industries.

There is a large potential for additional CHP in all sectors in the U.S., with significant energy and environmental benefits.

New technology provides the technology basis for broader applications.

Conclusions (2)

Institutional, regulatory and economic factors are the more important limits to this growth today.

Large PURPA-style leveraged projects are less likely in the future.

The last growth spurt for CHP was the direct result of a specific regulatory initiative (PURPA) - what will drive the next one?